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NO NEED OF A CHARGER TO CHARGE AN ELECTRICAL VEHICLE

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ABSTRACT

The increase in demand for transportation for human comfort has led to the tremendous use of petrol and diesel, which supports the community of pollution. So, to solve this problem we have invented ELECTRICAL VEHICLES (EVs) which are eco-friendly and do not emit any kind of pollution. But we are facing many kinds of problems in the range of EVs. After a particular distance travelled we need to charge our vehicle, which is very time-consuming. So, to solve this problem I came up with a solution which allows us to travel unlimited kilometers without charging our EV. This can be made possible when we use an inbuilt charging system in our EVs which we are going to discuss further in this paper.

KEYWORDS: Electrical Vehicle, Pollution, Charger & Eco-friendly

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Original Article

1. INTRODUCTION

The government is giving various kinds of subsidies on EVs but people are stepping back to buy them because of the following reasons:

- The speed is limited (approx. 80 km/hr).
- Less capacity to carry goods.
- At one charge it covers limited distance.
- It needs a lot of time to charge.
- Very few companies built fast-charging stations.

So, to solve this problem various researchers have invented a different kind of charging system. Mainly, there are 2 types of charging systems first one is the wired fast-charging system and the other is the wireless charging system [1].

1.1 Wired Fast Charging System

This system includes a fast DC charger that can be connected to the regular power socket. The average time to charge 100% battery of the EV is 4 hours. Now, the owner of the EV car companies are setting up the DC fast charger power station in the city as well as on the highways, but it may take years to completely build up the project worldwide. The other is a regular charger which takes approx 8 hours to fully charge the EV.

1.2 Wireless Charging System

It is a good system to charge an EV but it contains many barriers [2]. Firstly, it is a very slow charging system much power can't be transformed to EV from the charger. Secondly, the gap between the wireless power station and EV should be maintained which is very difficult because every company has a different dynamic design of EV [3]. Next, the cost of such power station is very expensive. There is one more system by which we can charge the

EV wirelessly when it is in motion. It will help us to increase the range of the EV and we don't need to carry large batteries with us as it will charge parallel to the road. But it also contains many hurdles in it. First thing is the power transmitted will be less. Secondly, the car should move on a particular track as it will cause misalignment between the EV and coil inside the road [4]. Finally, the cost to set up the idea on a large scale is way more expensive.

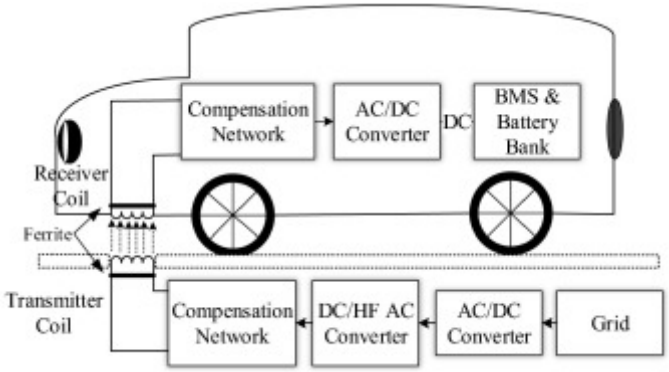

Figure 1: Basic Block Diagram of a Wireless Charging System for EVs.

Now, there is one more charging system that I am going to discuss further in detail i.e. INBUILT CHARGING SYSTEM (ICS). In ICS we don't need to carry a regular or a fast charger with us to charge the EV. This system consists of two main things, one is dynamo motor and the other is a fast charger that is inbuilt in the EV.

2. INBUILT CHARGING SYSTEM (ICS)

ICS is based on the principle that when an EV moves at a particular speed the rear wheels are connected to the dynamo motors which generate electricity for batteries. Let me explain it more clearly with the help of a block diagram.

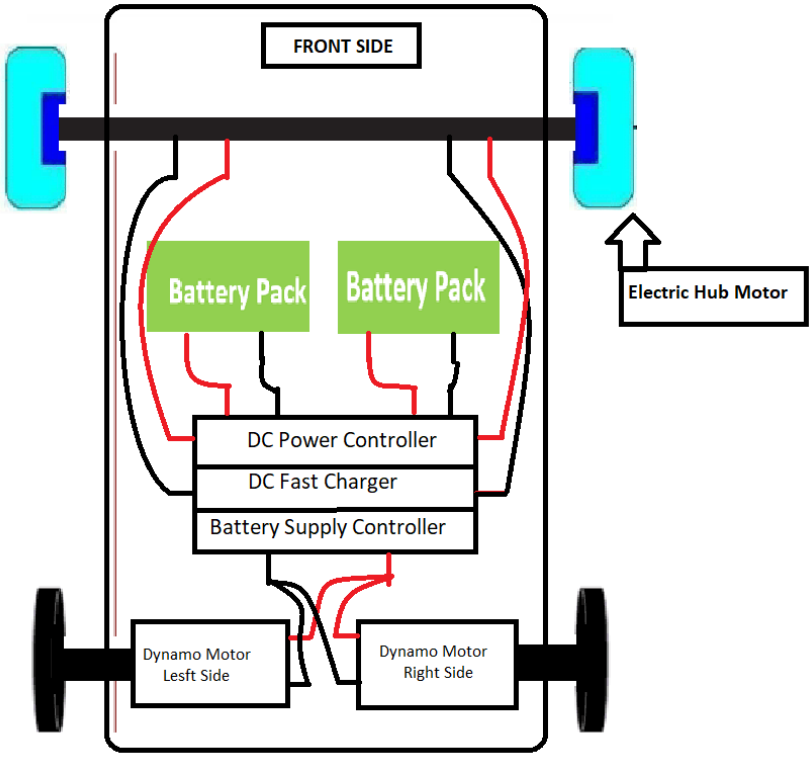

Figure 2: The Block Diagram of Inbuilt Charging System for EVs.

From the block diagram (figure 2) we get an overview of the ICS and the key part of this system. The ICS works when the EV is in running condition or in motion. The batteries supply electrical power to the front wheel hub motor which brings the EV in motion. Then, the rear wheels which are connected to the dynamo motors rotate parallel with the front hub motor wheels due to which the dynamo motor generates electricity for the batteries. When the power is generated by the dynamo motor it is sent to the "controller chip" which controls the DC power supply to maintain the steady flow in the hub motors. Secondly, the chip also contains a DC fast charger in it that gets DC output from the power controller and helps the batteries to get charge. Lastly, the chip also contained a power cut off system for the batteries. So, that the batteries get the continuous power supply and it does not get overcharged. The functions of the parts use in ICS are discussed below:

2.1 Two Electric Hub Motor

The electric hub motors which are inside the front wheels of the EV get the supply of power from the battery and bring the EV into motion from its rest position [5]. The electric motor can be of various voltages according to the use of EV. Where EV is concerned, the benefits are more obvious [6]. The weight of the metal in a typical car (including the engine, gearbox, and chassis) is perhaps 10 times the weight of its occupants, which is one of the reasons why cars are so very inefficient. Swap the heavy engine and gearbox for hub motors and batteries and you have a lighter car that uses energy far more efficiently. I have an example of 48 volts and 750 watts which we will discuss further. The electric hub motor mainly consists of rotor, wheel bearing, stator, vehicle suspension, microinverters (optional), conventional alloy wheel [7].

Figure 3: Labelled Diagram of an Electric Hub Motor.

2.2 Two Lithium-ion Batteries

I have used 2 lithium-ion batteries [8] in ICS because one battery is used to run the EV, while the other battery is getting charge parallel to it with the help of dynamo motor. Both the batteries are connected with the controller chip as its function is to manage the power. We are giving power to the electric motor and the power which we are receiving from the dynamo motor. Lithium-ion batteries are used because it contains more life cycles than any other battery and it also lasts for a long time [9]. Basically, the lithium-ion battery contains several cells which all together form a big battery. The battery consists of following parts:

- Copper current collector (anode)
- Aluminium collector (cathode)
- Li-metal oxides
- Lithium metal-carbon
- Separator
- Electrolyte

The process of discharge of the battery is vice-versa of the process of charging as shown in figure 4.

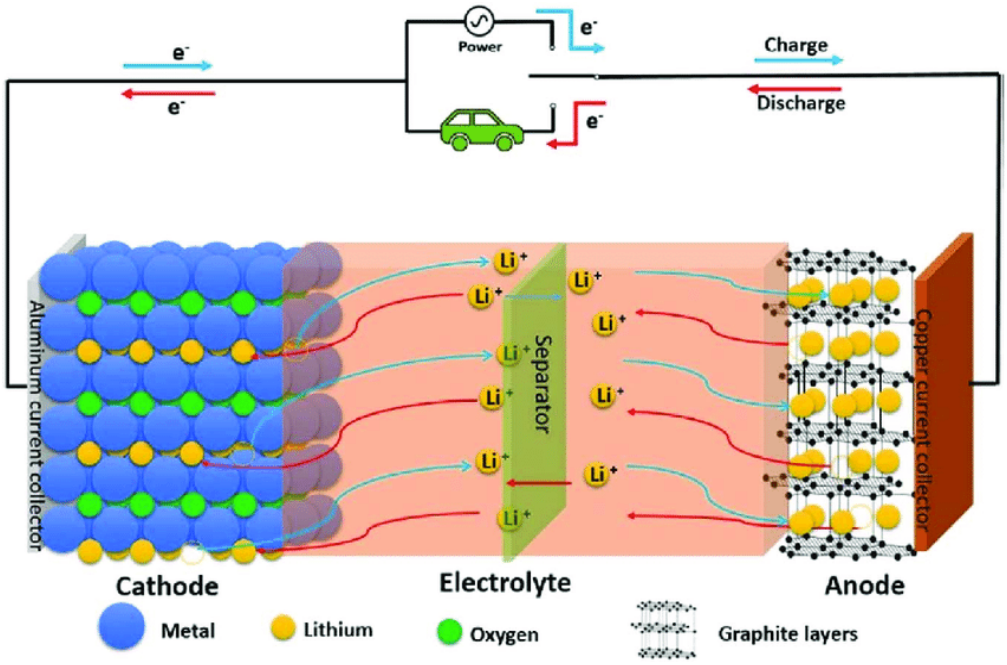

Figure 4: Diagram of Lithium-ion Battery getting Charge and Discharge.

2.3 Two Dynamo Motors

In ICS two dynamo motors [10] are used whose function is to generate electricity for the batteries to get charge. It works as a power source for EV. The dynamo motors are directly connected to the rear wheels with the help of shaft and it moves parallel with front wheels. Both the negative and positive terminals of the dynamo motor are connected to the controller chip [11] as it helps in managing the voltage coming from the dynamo motor. The motors also help in increasing the speed of the EV as at a particular speed the coil inside the dynamo motor moves automatically with the help of magnets [12] and thus also reduces friction [13] inside the dynamo motor. The diagram of the dynamo motor is shown in figure 5.

2.4 Controller Chip

It is the brain of the whole ICS as it manages and controls both the things, the power which we are getting from the dynamo motor and the power which we are giving to the electric motor [14]. It also helps in maintaining the charging level of the batteries. Particularly it has three main parts:

- DC power controller
- DC fast charger
- Battery supply controller

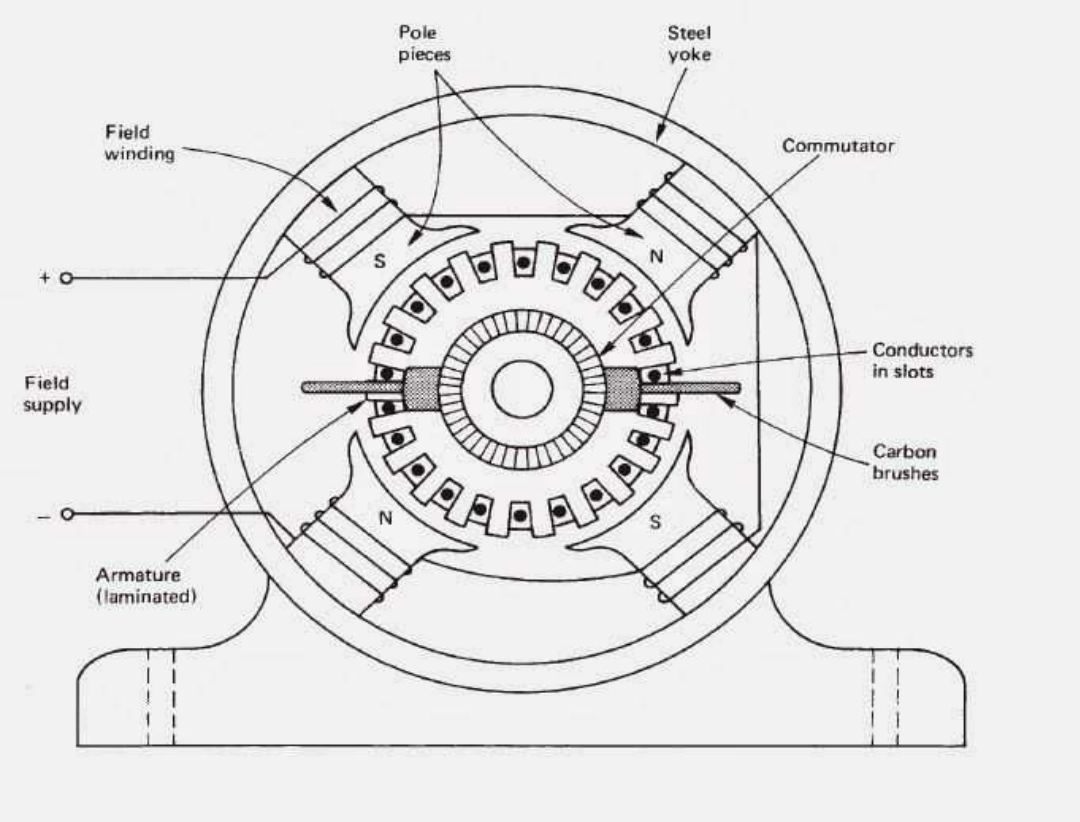

Figure 5: Block Diagram of DC Dynamo Motor.

DC Power Controller

The function of the DC power controller is to control the DC current which we are getting from the dynamo motor. It has to be maintained at a particular voltage because of the fluctuation in the voltage which is caused due to the increase and decrease of the speed in the EV [15]. It helps to manage the continuous flow of the current. So that, the battery can charge at a particular voltage because the fluctuation of the voltage can damage the batteries.

DC Fast Charger

Controller chip contains DC fast charger because the power which we are getting from the dynamo is sent to DC power controller and then it is forward to DC fast charger, from where the current flows into the battery and charge it. The DC fast charger has the efficiency to charge the battery 100% in just 4-5 hours. The benefit of the charger is that it can charge the EV when it is in motion.

Battery Supply Controller

The role of the battery supply controller in the ICS is that it helps to maintain the level of battery charge by the DC fast charger and also the level of the battery utilised by the EV. So, when the battery level goes to 10% the controller help in switching the EV on the battery which has been charged by the DC fast charger with the help of dynamo motor and so, on the process continuous. We can also maintain the voltage and current which we want to provide to the batteries.

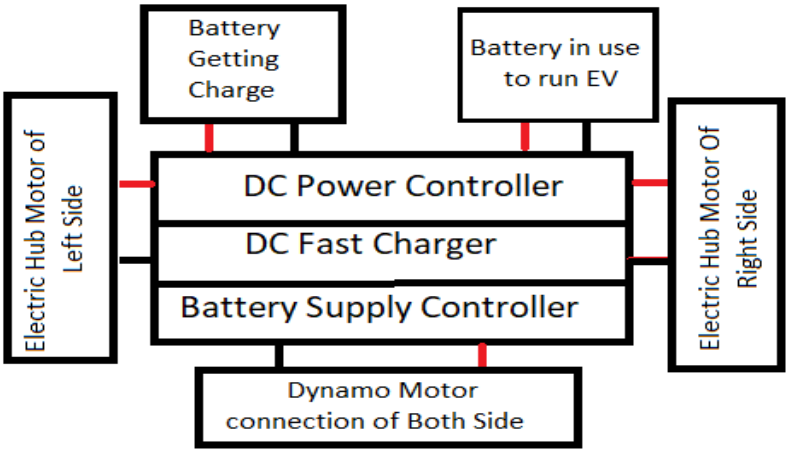

Figure 6: Block Diagram of the Controller Chip.

3. METHODOLOGY AND EXPERIMENT

For example take an EV that contains two motors of 120 volts and 750 watts, two batteries of 120 volts and 180ah, two dynamo motors of 120 volts and a controller chip that can manage the current of 180ah and voltage of 120 volts. Now, set up all the parts in the way as shown in figure 2. Hence, with the help of some basic formulas, we can calculate how much the EV can run on a single full charge and how much time the dynamo motor will get to charge the second battery.

Formulation

Speed*Time = Distance travelled

- The weight the motor can carry including the body and other parts of EV.

$$\text{Capacity} = \frac{\text{watt of motor}}{2}$$

$$\text{Capacity} = \frac{750}{2}$$

Capacity = 375 Kg

Hence, the motor has the capacity to carry the load of 375 Kg.

- As the electric motor is of 120 volts the maximum speed it can reach is between 100 to 120 Km/hr.
- The capacity of the battery to run at one full charge:-

The distance can cover = Ampere of battery * 2

= 180 * 2

= 360 Kilometres

Now, when the EV is running at an average speed of 72km/hr for how much time the battery can be utilised to run the EV on one full charge?

$$\text{Time} = \frac{\text{Ah} * 2}{\text{Volt}}$$

$$= \frac{180 * 2}{72}$$

$$= \frac{360}{72}$$

$$= 5 \text{ hours}$$

Hence, the battery can run for 5 hours continuously on an average speed of 72 Km/hr. So, basically, we get 5 hours to charge the second battery of the EV with the help of dynamo motor. As a result, with the help of DC fast charger which is inbuilt in the controller chip can charge the second battery fully in 4–5 hours as the fast charger have the efficiency to charge the battery in 4 hours. By this process, the whole ICS works for EV and there will be no need to carry a charger to charge the EV.

4. MULTI-GEAR SYSTEM

It is a system that contains multi gears connected to 3 different shafts and the gears are of two different sizes [16]. One gear is of small diameter which contain less number of teethes as compared to the second gear which contain larger diameter and more number of teethes.

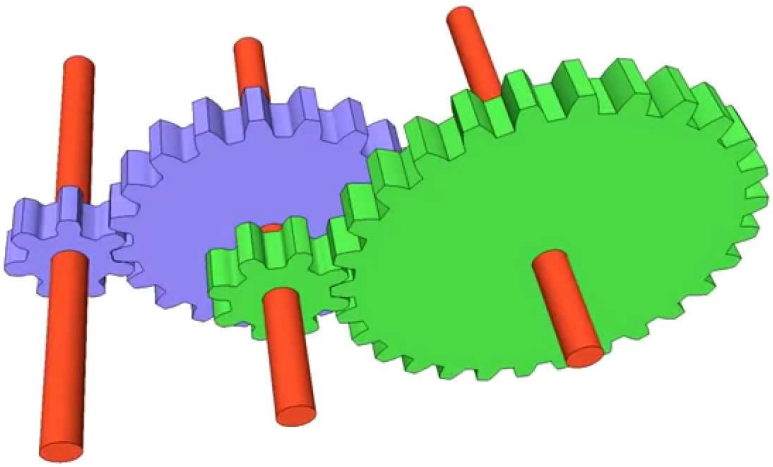

Figure 7: Block Diagram of Multi-gear System.

One shaft of the gear system is connected to the wheel while the 3rd shaft is connected to the dynamo motor which helps in generating electricity. The shaft which is connected to the wheel contains a large gear which is further connected to the smaller gear of the 2nd shaft, the same shaft also contains a larger gear which is again connected to the smaller gear of the 3rd shaft which is connected to dynamo motor [17]. This system is used to increase the speed of the dynamo motor as at some condition the EV runs at very slow speed. So, in that case, the multi-gear system help to increase the speed of the dynamo motor. It can run 4 times faster than the EV running at a particular speed at that time [18]. The working of this system is that when the small gear completes one full revolution at that time the large gear only completes half revolution and due to the fewer number of teethes on the small gear it completes one revolution, the process continues for both 2nd and 3rd shafts [19]. Hence, as a result we get 4 times more revolution than the wheels running on electric motor. For example if EV runs at 20 Km/hr we can get the speed to run the dynamo motor at 80 Km/hr.

5. CONCLUSIONS

In this study, a new solution for charging EV has been introduced which is called ICS (Inbuilt charging system). This system helps in solving many problems in which the EV is facing nowadays. The system is very beneficial for the upcoming new technologies in EV on a large scale [20]. This system can also be applied to commercial vehicles that carry huge loads. This system will also attract the customers who are stepping back to buy the EV because this system covers the max [21]. The problem is faced by the current EVs. It will also give a big rise to EV companies as the demand will increase in the future. Finally, ICS is one of the major solutions to solve the problem with EV [22].

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